# Living Standards in Black and White: Evidence from the Heights of Ohio Prison Inmates, 1829-1913

JEL: Codes: I31, J15, N31

Keywords: Stature, Inequality, Nineteenth Century US Race Relations

Thomas N. Maloney
Department of Economics
University of Utah
1645 Campus Center Dr., Rm 308
Salt Lake City, UT 84112
Phone 801-581-7704
Fax 801-585-5649
E-Mail: Maloney@economics.utah.edu

and

Scott Alan Carson
School of Business
University of Texas, Permian Basin
4901 East University
Odessa, TX 79762
Phone: 432-552-2195
Fax: 432-552-2174
E-Mail: Carson_s@utpb.edu

# Living Standards in Black and White: Evidence from the Heights of Ohio Prison Inmates, 1829-1913


## Abstract

The use of height data to measure living standards is now a well-established method in the economic history literature. Moreover, a number of core findings are widely agreed upon. There are still some populations, places, and times, however, for which anthropometric evidence remains limited. One such example is 19$^{th}$ century African-Americans in the Northern US. Here, we use new data from the Ohio state prison to track heights of black and white men incarcerated between 1829 and 1913. We corroborate the well-known mid-century height decline among white men. We find that black men were shorter than white men, throughout the century controlling for a number of characteristics. We also find a pattern of height decline among black men in mid-century similar to that found for white men.

# I. Introduction

Industrialization and modernization bring about rising incomes, wages and life expectancy in the long run (Komlos 1987; Floud, Wachter and Gregory 1990, pp. 272-273). However, in the short run they also create economic and social turmoil, such as increasing inequality and the spread of disease through migration and trade, which can lead to deteriorating biological living conditions. Hence, the overall effect of the early stages of industrialization and modernization on biological living standards depends on which of these effects dominates. A growing body of evidence indicates that the net effect was negative for most populations in Europe and North America in the early stages of industrialization. In the US during the second quarter of the 19$^{th}$ century, the average stature of native-born white males began a sustained diminution of about 2.5 centimeters (Komlos, 1987, 1996). We are not sure when the trend was reversed. Among South Carolina students, the trend was not reversed until the 1910s (Coclanis and Komlos, 1995).

While the rough outlines of this pattern are established, a full understanding of the details requires additional evidence. In particular, while a mid-century height decline has been found among free blacks in Maryland (Komlos 1992), little is known about the biological living standards of African-Americans in the North at this time. In this paper, we use a new data set collected from the records of the Ohio state prison in Columbus to compare the development of the biological living standards of black and white men in Ohio throughout the 19th century. This is an appropriate time and place in which to study the biological living standards of males in a rapidly developing economy. During the early 19th century, states such as Ohio, Illinois and Indiana were America's far western frontier. By the mid-19th century, these states were beginning to develop an industrial sector. By the end of the 19th century, the Great Lakes region had substantial manufacturing.

In addition, our data are well suited for constructing racial comparisons in the North. While existing studies of African-American biological living standards tend to rely on race-specific documents, including slave records and identification cards issued to free blacks in the South, we have large samples of both black and white individuals from a uniform set of records from the Ohio state prison. Our data set also covers an unusually long time period, allowing us to examine developments both before and after the Civil War. Using these data, we examine the following questions: First, how did biological living conditions vary across demographic, geographic, and socioeconomic categories for men in Ohio? Second, how large were stature differences between blacks and whites and what were their sources? Finally, did blacks in Ohio experience the same kind of stature decline that whites experienced?

## II. Biological Living Standards in the Nineteenth Century US

As the literature on biological living standards has grown dramatically, some fundamental findings have come to command nearly universal assent. Perhaps the best known of these is the existence of the "antebellum paradox": the decline in average heights for many groups beginning around 1835, even as average incomes grew robustly (Steckel 1995, p. 1920; Komlos 1987, 1996). This pattern in heights is corroborated in mortality data: life expectancy declined across birth cohorts in the mid-1800s (Pope 1992; Haines 2004). It appears that the mortality decline began earlier and bottomed out earlier than did the height decline. This is what we would expect if mortality reflects the impact of changing conditions nearly contemporaneously, while adult height mainly reflects conditions in one's infancy and adolescence.

What caused this decline in biological living conditions? Here consensus is of more recent vintage. Growing urbanization probably reduced average heights, but this could only reasonably account for a small share of the observed change. Heights declined in both rural and urban areas, so the aggregate decline was not mainly a matter of an increasing share of the population living in urban areas (Steckel 1995, p. 1927). Growing income inequality played a role, as heights appear not to have declined among some better off groups (Steckel, 1995, p. 1928), including urban, middle-class passport holders (Sunder 2003). Some scholars have focused on declining nutrition as a source of height decline. Rising relative prices for food may have encouraged substitution into other goods, reducing adult height (Komlos 1987, p. 917). Haines, Craig, and Weiss (2003) and Cuff (2005, pp. 49, 82-99) find that counties with nutritional surpluses were characterized by taller populations. Sunder (2004) argues that stable heights among

Tennessee convicts reflected agricultural self-sufficiency and unusually good conditions of protein supply in the state. Other scholars have emphasized the effects of the spread of disease through trade, migration, the increased scale of workplaces, and the growth of public schooling. Distinct from the long-term trend, cycles in height appear to have been correlated with business cycles (Woitek, 2003; Sunder and Woitek, 2005).

In addition to the analysis of change in heights over time, a number of cross-sectional differences have been identified. Farmers were relatively tall, and this health advantage reflected isolation from disease as well as access to good nutrition (Komlos and Coclanis 1997, p. 441; Steckel and Haurin 1994, p. 123; Margo and Steckel 1983, p. 170; Sokoloff and Villaflor, 1982, p. 463; Lee 1997; Costa, 1993, p. 364-366). Proximity to water tended to reduce height because of increased disease incidence directly related to the presence of water and also because of exposure to trade and migration along water transport routes (Craig and Weiss, 1998, pp. 194, 197, and 205; Haines, Craig, and Weiss 2003, pp. 395 and 408; Steckel 1992, p. 297). There was also variation in average height across regions in the US, particularly a substantial height advantage for Southerners (Steckel 1995, p. 1921; Carson, 2007).

While most of the sources used to establish these patterns include only white men, there is also a substantial literature on the biological living conditions of blacks under slavery. Black slaves reached adult heights well below those of whites, and slave children experienced profound height and health deficits (Steckel, 1986), as expected. However, the trend of black heights in the South does reveal some surprises. Komlos and Coclanis (1997) document increasing average stature for black convicts in Georgia in the antebellum period, and Steckel (1979) finds a similar increase among transported slaves.

Komlos and Coclanis, as well as Rees et al (2003), argue that male slave heights did not decline in the antebellum period because it paid for their owners to maintain their nutritional status; otherwise their productivity would have been affected. This is in marked contrast to height reductions among whites in this period.

Evidence on free blacks in the 19th century is also largely from the South and largely from the antebellum period. Bodenhorn (1999) studies registration records for free blacks in Virginia and finds a pattern that contrasts somewhat with the pattern observed among slaves. While free blacks in Virginia were generally one to two cm taller than slaves (Bodenhorn, 1999, p. 985-6), their height declined between 1800 and 1830 (dating by birth cohorts), in contrast to increases in slave heights during this era. Using similar records for Maryland, Komlos (1992) documents a decline in the average heights of free male and female blacks in that state between the 1820s and the 1840s. Thus, free Southern blacks experienced a decline in average height in the antebellum period similar to that found for whites while slaves did not.

## III. Race and Living Standards in Ohio during the 1800s

In order to expand our knowledge further, we examine evidence on the heights of black and white prisoners in Ohio in the 1800s. Ohio occupies a complex place in 19th century African-American history. It was central to the operation of the underground railroad, through which tens of thousands of slaves passed on their way to freedom (Johnson and Campbell 1981, p. 36). At the same time, Ohio's antebellum legal restrictions on blacks, while "by no means unique," were "certainly among the most severe" in the North (Gerber 1976, p. 9). Beginning in 1804, blacks in Ohio were

required to obtain a "certificate of freedom" in order to live and work in the state, and beginning in 1807 they were required to post a $500 bond with their county clerk within 20 days of arriving in the state, though the law was only sporadically enforced (Cayton 2002, p. 9, 110; Johnson and Campbell 1981, p. 39). Black children were forbidden from attending public school until the 1840s, and legally segregated schools predominated from the 1840s to the 1880s (Cayton 2002, p. 61, 200). Notably, though blacks gained access to the vote under the 15th amendment in 1870, the explicit (but ineffectual) restriction of suffrage remained in the Ohio state constitution until 1923 (Ibid., p. 231).

There was some variation within Ohio in the status of the black community. The southern part of the state generally placed the greatest limits, both explicit and implicit, on African-American life. This may have reflected anxieties about the potential influx of large numbers of blacks from Kentucky and Virginia, as well as close cultural and economic ties between Ohioans in this part of the state and residents of the South (Gerber 1976, pp. 9-11). In the Northern part of the state, the (substantially smaller) black community enjoyed somewhat greater openness. For instance, Cleveland began to subsidize local black schools in 1843 and abolished segregation in local schools in the 1850s (while the state did not pass a school desegregation law until 1887) (Cayton 2002, p. 62-3, 200).

The end of the Civil War brought considerable change in the size and circumstances of Ohio's black community. The black population of Ohio rose from 36,673 in 1860 to 63,213 in 1870. Though blacks were still less than 3 % of the population of the state, this increase was the fastest among all Northern states during this decade, leaving Ohio second to Pennsylvania in total black population and second to New

Jersey in percent black among Northern states. The arrival of black refugees during the war initially provoked an "hysterical" response, including the passage of a miscegenation law in 1861. However, the fact that many of the wartime and post-war black migrants to Ohio moved as families and settled in rural areas may have dampened the reaction of whites somewhat (Gerber 1976, pp. 28-33).

The pace of increase in Ohio's black population slowed substantially over time: the 72 % growth of the 1860s was followed by a 26 % increase in the 1870s and a 9 % increase in the 1880s. In 1870, half of all Ohio blacks were Southern born, but this share fell to 36 % in 1900 as migration slowed. Much of the growth of the black population was concentrated in the southern and western parts of the state. Where the black community was growing most rapidly, efforts to constrain their economic and political aspirations were apparently most severe (Bertaux 1993, pp. 141-2).

Most research on heights in the 19$^{th}$ century US places individuals in the Midwest in the middle of the height spectrum (Steckel 1992, p. 289). Steckel and Haurin (1994, pp. 121-122) examine heights using measurements of 19$^{th}$ century Ohio National Guardsman. They document a ranking of heights across occupations: as in most other studies, professionals were the tallest, followed by farmers, clerical workers, and skilled and unskilled laborers. Native-born National Guardsmen were taller than foreign-born recruits by nearly one inch, a finding corroborated by Sokoloff an Vilaflor in their military data from the Revolutionary War, the French and Indian War, and the late 1810s (Sokoloff and Vilaflor 1982, pp. 462-464). Rural residents within Ohio were nearly one quarter inch taller than urban residents. Steckel and Haurin's results also indicate a slightly declining trend in height for cohorts born after about 1870.

These political and demographic trends highlight three general patterns that are relevant for our comparison of whites and blacks in Ohio. First, region of birth mattered, both because heights in general varied across regions and because the share of the black population born into slavery or freedom varied. Second, region of residence within Ohio may have mattered, if blacks in the Southern part of the state faced greater obstacles to economic advancement. Finally, the general cross-sectional differences noted above – the height advantage of farmers, disadvantages for those who lived close to water and in urban areas – no doubt applied within Ohio and could have affected racial differences, if blacks and whites were distributed differently across these categories.

## IV. The Ohio Prison Data

Our Ohio data include records for almost 30,000 native-born male inmates received into the Ohio prison system between 1829 and 1913.[1] All records with complete information on age, stature, occupation and nativity were collected. Because the comparison here is between black and white American males, immigrants are excluded

[1]The data we use to study black and white stature in Ohio is a subset of a much larger 19th century prison sample which also includes all available records from state repositories in Arizona, California, Colorado, Idaho, Illinois, Kansas, Kentucky, Missouri, New Mexico, Ohio, Oregon, Pennsylvania, Texas, Utah and Washington. Records for the Ohio prison were obtained from from the Ohio Historical Society, 1982 Velma Avenue, Columbus, Ohio 43211 (http://www.ohiohistory.org/resource/statearc/). The first Ohio penitentiary was established in 1815 and housed a prison population of 150 inmates in the first five years of operation. A second prison, built near the site of the first, was completed in 1834 (Finley, 1857). This is the penitentiary from which our records are extracted. Note that the records for inmates received into this prison in 1868 were unavailable.

from the analysis. While many stature measurements in other 19th-century sources were rounded to the nearest inch or half inch, our inmates' statures were recorded at quarter, eighth, and even sixteenth-inch increments.[2] There was great care in recording inmate statures because accurate measurement had legal implications in the event that inmates escaped and were later recaptured.

Prison officials routinely recorded the dates inmates were received, age at incarceration, complexion, state of birth, stature, pre-incarceration occupation, the county in which the inmate was convicted and the inmate's crime. "Race" was not recorded explicitly in the prison records but can be inferred from the detailed descriptions of "complexion" that are provided. Inmate enumerators were quite thorough when recording inmate complexion, providing a detailed list of categories that we can relatively easily group as "white" or "black." Because other authors (see Steckel 1979; Margo and Steckel 1982; Bodenhorn 1999, 2002; Bodenhorn and Ruebeck 2007) have identified stature and socioeconomic distinctions between "mulattos," or African Americans with "light skin" and European features, and the general black population, we identify this group and test for stature differences between them and the rest of the Ohio black prison population in our regression analysis.[3]

---

[2] 68.5 % of heights were recorded as fractions.

[3] Following Komlos and Coclanis (1997), we code as "black" all inmates with complexions recorded as black, brown, copper, dark brown, dark mulatto, ginger, light brown, light mulatto, mulatto and yellow. We additionally identify as "mulattos" those blacks who had complexions recorded as "dirty yellow," "light brown," "yellow," "mulatto," or obvious variations of these terms. Inmates with complexions recorded as fair, florid, dark, light, ruddy, sallow, sandy and swarthy are considered as from European ancestry and are coded "white."

The county in which the inmate was convicted is used to identify whether the inmate lived in the southern part of the state or close to water, in order to test for the sort of geographic effects discussed above. Counties that bordered the Ohio, Great Miami, Scioto and Muskingum rivers are classified as having access to a major water way. There is some evidence that these rivers were navigable around this time and thus a possible conduit for diseases carried by trade (Becker and Johnson, 1991). Counties that bordered lakes are Ashtabula, Cuyahoga, Erie, Lake, Lorain, Lucas, and Ottawa counties. This classification is of course noisy, as the individual's usual residence might not have been in the county in which he was convicted.

All historical height data have selection biases, and prison and military records are the most common sources of evidence on height. One common shortfall of military samples is a truncation bias imposed by minimum stature requirements (Fogel et al, 1978, p. 85; Sokoloff and Villaflor, 1982, p. 457, Figure 1). Fortunately, prison records do not suffer from such a constraint and the subsequent truncation bias observed in military samples. However, prison records are not above scrutiny. Prison data may contain a disproportionate number of the materially poorest individuals (Riggs, 1994, p. 64). This form of selectivity may have advantages in stature studies, as these individuals were more vulnerable to economic change (Bogin, 1991, p. 288).[4] On the other hand, if this selectivity varied over time, it may affect the trends in height that we observe.

---

[4] Without question, the prison was not a healthy environment. Close proximity to other inmates and unsanitary conditions facilitated the spread of disease. For instance, the cholera epidemic of 1849 killed 121 of the 423 inmates resident in the prison. Note, though, that our evidence on heights is not affected by conditions within the prison because measurements were taken as inmates were received and therefore reflect their pre-incarceration living standards.

[Insert Table1 here]

One way to investigate this possibility is to examine the crimes for which individuals were incarcerated. For example, prisoners incarcerated for theft may have been shorter than other prisoners because theft is a sign of poverty. If more individuals were incarcerated over time for theft, such a change in the composition of the prison population could have produced declining average heights in the prison that would have been unrelated to patterns in average height of the general population. However, Table 1 demonstrates that the share of black and white prison entrants incarcerated for theft and property crimes decreased over time, indicating height diminution was not likely the result of increasing selection of poorer individuals into the prison.

We can gain further insight into the pattern of selection of the prison sample from the general population by comparing the occupational structures of the two groups. Table 2 presents occupation tables for adult men (aged 23-55) in Ohio based on the Integrated Public Use Microdata Series (IPUMS) samples for 1850 to 1910, along with the occupations of adult inmates entering the prison between 1850 and 1910 (Ruggles et al., 2004). We present these numbers for the full period, and also for early (1850-1870) and late (1880-1910) sub-periods. The main difference among the white adults is that inmates were more likely than average to be skilled production workers (including, for instance, construction trade workers, skilled metal workers, and mechanics), and they were less likely than average to be farmers. White collar workers and unskilled workers were about proportionally represented in the prison among whites. These patterns of selection held even as the overall occupational structure experienced considerable transformation, marked by the decline of employment in agriculture and rising shares in

the unskilled and white collar categories. Among blacks, the pattern of selection into the prison was somewhat different. Black white collar workers, skilled workers, and farmers were all over-represented in the prison, while black unskilled laborers were actually underrepresented. Again, this pattern of selection was generally consistent over time even as the overall occupational structure changed. On the whole, neither black nor white prisoners were primarily drawn from among unskilled laborers, the group likely to be most impoverished. Note that, while more detailed occupational information is available in the prison records, in our analysis of heights we focus on the distinction between farmers and non-farmers.

[Insert Table 2 here]

## V. The Heights of Ohio's Black and White Prisoners

Our analysis considers inmates ranging in age from 14 to 55. Obviously, the younger inmates in our sample were still growing. While modern height distributions suggest that adult height is reached about age 20, there appears to have been ongoing growth through about age 22 for the nutritionally poorer population of the 1800s (Tanner, 1977, pp. 308-309). For this reason, we analyze youths aged 14 to 22 separately from adults (aged 23 to 55). In addition, variation in the age composition of the youth sample either over time or across categories could create misleading variation in youth heights. To control for age composition among the young, we construct age-standardized height measures as follows: we pool the sample across all birth years and calculate overall age-specific height means for whites. We then standardize the height of each individual (both

blacks and whites) by the white mean for the given age. We present height distributions for adults and youths (using the standardized measure), separately by race, in Figure 1. Heights were approximately normally distributed for all four groups.

[Figure 1 about here]

Table 3 presents average heights for white and black adult men (older than 22) in our sample, disaggregated on a variety of dimensions including birth cohort, farm residence, region of birth, and proximity to water. For both groups, the cross-sectional patterns found in the broader literature described above are corroborated: farmers were taller than non-farmers, and individuals convicted in counties near water were somewhat shorter than individuals convicted elsewhere. Among blacks, mulatto individuals were taller than others. Region-of-birth patterns for blacks and whites were similar in some ways. For both groups, individuals born in the Middle Atlantic and the Great Lakes region were short. Notably, though, Southern-born whites were taller than whites born anywhere else (as has been found in other data sets), while Southern-born blacks were not taller than blacks born in other regions (except, perhaps, the Middle Atlantic states). The climate, disease, or nutritional advantages that generated tall white Southerners, combined with the physically demanding conditions faced by slaves, created an over 2 cm height differential between blacks and whites born in the South (Margo and Steckel, 1982; Sunder, 2004; Carson, 2007).

[Table 3 about here]

Given the discussion in the narrative history of variation in black status within Ohio, especially the particularly severe limitations on black status in the southern part of the state, we also calculate average heights separately for those convicted in the two-

county band along the state's southern border. Whites in these counties were slightly taller than whites in the rest of the state, while blacks were somewhat shorter. This within-state geographic variation in the black-white gap is not very large, though. Note also that old-age height decline has been found to begin in the late 40s for individuals who lived in the 19th century. This is corroborated in Table 3: Individuals aged 46 to 55 were shorter than individuals aged 23-55.

Within all categories, white heights exceeded black heights. It is important to keep in mind that there do not appear to be systematic differences in height potential between blacks and whites in the US when biological living conditions are held constant (Eveleth and Tanner, 1976; Tanner, 1977; Barondess, Nelson and Schlaen, 1997, p. 968; Komlos and Baur, 2004, pp. 64, 69; Nelson et al., 1993, pp. 18-20; Godoy et al, 2005, pp. 472-473). Therefore, the ubiquitous height disadvantage of black inmates in our data probably reflects racial differences in access to nutrition, work effort, and exposure to disease.

The trend in height corroborates the pattern of decline in the mid-1800s which has been frequently demonstrated for whites and free blacks (Komlos, 1992). Our evidence shows that the heights of Ohio-resident blacks started to decline in the 1820s. The average height of Ohio-resident whites fell between 1790 and 1800, but persistent decline in their average stature began in 1830 (see Figure 2). While the decline occurs for both blacks and whites, it is somewhat steeper for blacks through 1840, with some absolute and relative recovery for this group after that point.[5]

[5] Comparing our white inmates to Steckel and Haurin's Ohio National Guard sample indicates that our prisoners were shorter, probably because the guard data had a minimum stature requirement. For

[Figure 2 about here]

Regional differences in height, changes in migration patterns, and selectivity in migration might affect these basic patterns. For example, the share of the adult white sample born in the South fell from about 25 % in 1800 to about 10 % in 1880. This change would probably lead to declining average heights among whites in our sample, all else equal. Among blacks, change in the selectivity of migration, due to the Civil War and emancipation, may have caused some change in average heights over time. As an initial control for these kinds of compositional effects, we calculate the time path of height separately for the Ohio-born (Figure 2). The general decline across birth cohorts is still apparent, as is the white height advantage in each decade. (In the regression analysis below, we will control for region of birth directly.)

This average decline reflects changes that occurred throughout the height distribution for both blacks and whites (Figure 3). There was roughly a two centimeter decline in height at the 75$^{th}$ percentile, the median, and the 25$^{th}$ percentile of the height distribution for both groups during the 1800s. This pattern indicates that the decline in mean height was not driven solely by worsening conditions at the very bottom – e.g., a widening income distribution and greater impoverishment of the poor. Note also that there appears to be some convergence in black and white heights at the top of the distribution after 1840, and at median and low heights after 1860 and 1850.

[Figure 3 about here]

---

Guardsmen born between 1840 and 1880, Steckel and Haurin find average heights of between 68.4 and 68.9 inches, or 173.74 to 175.01 cm, depending on location of residence, and their sample exhibits little net change in average height over this period (the decline in their sample comes later – see Steckel and Haurin, 1994, pp. 123-124).

Raw mean height of youth (cm) by age and race are presented in Table 4, along with standardized heights by characteristic. As among adults, the black-white gap among Southern-born youth was quite large. The patterns related to farming, mulatto complexion, and proximity to water appear as expected. For youth, the racial gap within southern counties in Ohio did not exceed the gap within non-southern counties.

[Table 4 about here]

Age-specific height means for adolescents demonstrate that average black height exceeded average white height at ages 14 and 15, but thereafter growth was much more rapid for young white men. The growth process lasted somewhat longer for black youth, though, producing some net catch-up after age 19 (Figure 4). This finding of shorter adult height but a longer growth process for biologically less well-off populations fits patterns documented elsewhere (Cuff, 2005, p. 16; Steckel, 1979, pp. 367-369; Komlos and Breitfelder, 2007).

[Figure 4 about here]

The age-standardized height of white youth fell by about 1 % during the 1800s. For black youth, the height index fell by a little more than a point between 1810 and 1880 before rebounding in the 1890s (Figure 5). Restricting the sample to the Ohio-born produces a more dramatic decline over time for whites. White youth heights exceed black youth heights in all cases, except for the 1830s cohort in the all-region sample.

[Figure 5 about here]

To identify more rigorously these demographic and chronological height differentials, we estimate regression models of height as a function of the variables discussed above stratified by race, separately for adults and youths. Table 5 presents the

overall mean height and the means of the variables included in the regression analysis, calculated separately by race and adult or youth status.[6] For both adults and youths, the black sample is disproportionately concentrated in the shorter (post-Civil War) birth cohorts, and blacks are less likely to be farm residents but more likely to live close to water. All of these factors could contribute to the overall black-white height gap.

[Table 5 about here]

The overall average height difference between adult blacks and whites is about 1.6 cm (see Table 3). The coefficient on "black" in the pooled regression indicates that essentially all of the average racial difference remains in the presence of our control variables (Table 6).[7] Like Steckel (1979), Margo and Steckel (1982), and Bodenhorn (1999, 2002), we also find a positive "mulatto" effect on height. The advantage of farm

---

[6] As the independent variables in the regression analysis are all categorical, these figures indicate the distribution of the regression sample across birth cohort, region of birth, proximity to lake or river, farm residence, conviction in a southern county, mulatto status (for blacks), and age categories.

[7] An inmate's county of conviction may not have been a county in which the inmate had spent much of his life, and this mismatch may dilute the evidence on water and "southern county" effects. To refine our estimation of these effects, we reran the regressions using only Ohio-born inmates, presuming that these individuals are more likely to have spent considerable time in the indicated county than are those born in other states. In these regressions, the lake, river, and southern county effects are in fact larger in magnitude. In the pooled adult regression, the coefficient on "lake"is -1.199 (p=.01), the coefficient on "river" is -0.538 (p=.01), and the coefficient on "southern county" is 0.512 (p=.01). For white adults, the effects are -1.183 for lake (p=.01), -0.457 for river (p=.01), and 0.498 for southern county (p=.01). For black adults, they are -1.633 for lake (p=.03), -1.116 for river (p=.03), and 0.420 for southern county (p=.40).

residence and the disadvantage of proximity to water are also apparent in all of these results.

Examining separate regressions for blacks and whites, however, does allow us to identify some differences in the patterns. Here we can see the advantage held by whites born in the South. In addition, while older white men (over age 45) were shorter than those aged 23 to 45, older black men were not shorter than younger adult blacks. The decline among whites at older ages fits the pattern others have found for this period. The lack of such a decline among blacks may reflect an offsetting selection effect resulting from higher mortality: More so than among whites, only particularly healthy blacks were able to survive to these relatively advanced ages, and these individuals manifested less age-induced height decline than among the larger, less-select population of surviving white men (Haines, 2006; Meeker 1976; Jousilahti et al, 2000, p. 1114; Herbert et al, 1992, p. 1437; Song et al, 2003, p. 481). Between 1800 and 1870, black and white mean heights decreased by over 2.0 cm and then stabilized in the 1880-1890 period. The largest decline was experienced by the 1830s and 1840s birth cohorts.[8]

[Table 6 about here]

[8] There are statistically significant declines in the pooled regression between 1780/90 and 1800 (p=.08), 1820 and 1830 (p=.04), 1830 and 1840 (p=.01), and 1840 and 1850 (p=.03) (dating by birth cohorts). Among whites, there are statistically significant declines in height from 1820 to 1830 (p=.05), 1830 to 1840 (p=.01), 1840 to 1850 (p=.01), and1860 to 1870 (p=.02). For blacks, there was a statistically significant decline between the 1830 and 1840 cohort (p=.08), and then partial recovery from 1840 to 1850 (p=.01). The set of birth cohort controls is statistically significant at the .01 level in each regression.

Height regressions for youths (aged 14 to 22) are reported in Table 7. Because we control for age explicitly, we use height in centimeters as the dependent variable. As was found for adults, the results of the pooled youth regression indicate that nearly all of the average black-white height difference (about 1.4 cm) remains in the presence of our control variables. We again find advantages from farm residence, disadvantages from proximity to water (except in the black-only regression), a large advantage from Southern birth for whites, and no advantage for Southern-born blacks.[9] We do not find a "mulatto" effect among African-American youth. The timing of height decline appears to have been somewhat different for these adolescents than for adults, with more of the decline occurring among post-Civil War birth cohorts. In the pooled regression, there is a statistically significant decline in height between the 1810 and 1820 birth cohorts (p=.06), recovery between 1850 and 1860, and then further decline from 1860 to 1870. The same pattern is found for whites. For black youth, there is statistically significant decline in height from 1830 to 1840 (p=.08), along with recovery from 1850 to 1860 and then

[9] We again reran the regressions incorporating only the Ohio-born, to get a better sense of the river, lake, and "southern county" effects for a less-migratory group. The impact here is more mixed. In the pooled regression, the lake (coefficient = -0.442, p=.14) and river (coefficient = -0.497, p=.03) effects increase modestly, and the southern county effect is reduced and becomes clearly insignificant (coefficient=0.176, p=.44). The same pattern holds among whites – small increases in the magnitude of the lake (coefficient=-0.540, p=.08) and river (coefficient=-0.466, p=.06) effects, and a reduction in the southern county effect (coefficient=0.064, p=.80). For black youth born in Ohio, all of these effects are insignificant (the lake coefficient = 0.253 with p=.81, the river coefficient=-0.488 with p=.39, and the southern county coefficient=0.22 with p=.16).

decline from 1860 to 1870.[10] As among adults, the changes over time were somewhat more pronounced for blacks than for whites, at least in these point estimates.

[Table 7 about here]

To place these results in context, we compare our Ohio inmates to inmates in Missouri, Texas, and Georgia (Carson 2006, 2007; Komlos and Coclanis 1997).[11] We focus here on the changes in stature observed among adults. The patterns for whites in Georgia, Texas, and Ohio are quite similar to each other, with persistent height decline after 1820 (Figure 6). Missouri whites are something of an anomaly, with no persistent reduction in stature evident in their case.

Among African Americans, there is a sharp contrast between patterns in these southern states and our findings for Ohio (Figure 7). In Texas and Missouri, African-American stature increased through about 1850. In Georgia, African American stature did not decline until after 1840. For black convicts in Ohio, however, there was ongoing and substantial stature decline across birth cohorts from 1790 to 1840. This decline among Ohio's black convicts ended just as heights began to decline among black

---

[10] The set of birth cohort effects is significant as a group in the pooled regressions (p=.01), in the white regressions (p=.01), and in the black regressions (p=.08).

[11] These figures are based on Tables 6 and 7 for Ohio; Carson 2007 Tables 4 and 5 for Missouri; Carson 2006 Table 2 for Texas; and Komlos and Coclanis 1997 Tables 2 and 3 for Georgia. In all cases, we use intercepts and birth-cohort coefficients from race-specific stature regressions. In the Missouri figures, heights are presented for unskilled workers born in the Plains states. In the Texas figures, heights are presented for unskilled workers born in the Southeast. In the Georgia figures, heights are presented for unskilled workers born in Georgia and convicted in the plantation belt. In the Ohio figures, heights are presented for non-farmers born in Ohio.

convicts in Georgia, Missouri, and Texas. This contrast might reflect the influence of slavery on stature trends for African Americans in the South. Many African-American convicts in Missouri, Texas, and Georgia who were born before 1850 would have lived much of their early lives under slavery. The manipulation of slave nutrition by slave owners may have inhibited stature decline for these cohorts. African American convicts in these states who were born later would have experienced more of their growing years outside of the slavery regime and in the impoverished post-Civil War South, leading to stature decline at that point. Ohio's African American convicts were less likely to have spent their growing years under slavery, and changes in their stature more closely match the patterns found among whites.

[Figures 6 and 7 here]

## VI. Conclusion

Our data on nearly a century of inmate records from the Ohio state prison provide a rare opportunity to examine the heights of free, Northern-resident blacks in the 1800s and to compare their heights to those of whites measured at the same time for the same purposes. Our results indicate that the average heights of African-Americans in Ohio declined just as the average heights of white residents of Ohio did, but the timing of black stature declines preceded that of whites, as we would expect given that lower incomes meant greater vulnerability of the black population to nutritional shocks. On the whole, the negative biological consequences of the initial expansion of industrialization and trade affected free blacks and whites in similar ways, despite the substantial differences in their places of origin and other conditions of their lives. We also find that the height advantage of Southern birth was quite apparent for whites but did not extend to blacks.

Any general benefits from the lower population density and more rural conditions of a Southern childhood were, not surprisingly, overwhelmed by the profound biological challenges of slave life. Finally, while African-Americans and European-Americans achieve comparable average height when brought to maturity under similar biological conditions, we find that, controlling for many relevant factors, substantial and statistically significant height differences persisted between whites and blacks in Ohio in the 1800s.

These persistent and broad differences reflect the generally poorer, less healthy living conditions faced by African-Americans throughout the 1800s. Importantly, though, these differences tell us not just about the health history of blacks and whites but also about their health prospects. A wide variety of chronic health impairments are correlated with adult height, as is age-specific mortality risk (Fogel 1994, p. 375). Racial differences in living conditions faced by a parental generation, which affect the living standards of their offspring in infancy, early childhood, and adolescence, create differences in the health conditions faced by those offspring later in life. In this fashion, as in others, racial inequality is projected across generations.

## References

Barondess, D.A., Nelson, D.A., Schlaen, S.E., 1997, Whole Body Bone, Fat and Lean Mass in Black and White Men. Journal of Bone and Mineral Research 12, 967-971.

Becker, C.M., Johnson, L., 1991, History at the Bar: Navigability of the Great Miami River, The Journal of Transport History 12, 154-163.

Bertaux, N., 1993, Structural Economic Change and Occupational Decline among Black Workers in Nineteenth-Century Cincinnati. In: Taylor, H.L. (Ed.). Race and the City: Work, Community, and Protest in Cincinnati, 1820-1970. University of Illinois Press, Urbana, pp. 126-155.

Bodenhorn, H., 1999, A Troublesome Caste: Height and Nutrition of Antebellum Virginia's Rural Free Blacks. Journal of Economic History 59, 972-996.

Bodenhorn, H., 2003, The Complexion Gap: The Economic Consequences of Color among Free African Americans in the Rural Antebellum South. Advances in Agricultural Economic History 2, 41-73.

Bodenhorn, H., Ruebeck, H., 2007, Colourism and African-American Wealth: Evidence from the Nineteenth-Century South. Journal of Population Economics 20, 599-620.

Bogin, B., 1991, Measurement of Growth Variability and Environmental Quality in Guatemalan Children. Annals of Human Biology 18, 285-294.

Carson, S.A., forthcoming, African –American and White Inequality in the 19th Century American South: A Biological Comparison, Journal of Population Economics.

Carson, S.A., 2006, African American and White Living Standards in the 19th Century American South: A Biological Comparison. CESIfo Working Paper No. 1696.

Carson, S.A., 2007, African American and White Inequality in the American South: Evidence from the 19th Century Missouri State Prison. CESIfo Working Paper No. 1954.

Cayton, A.R.L., 2002, Ohio: The History of a People. (Ohio State University Press, Columbus).

Coclanis, P. and J. Komlos, 1995, Nutrition and Economic Development in Post-Reconstruction South Carolina: An Anthropometric Approach. Social Science History 19, 91-115.

Costa, D., 1993, Height, Wealth and Disease among Native-born in the Rural, Antebellum North. Social Science History 17, 355-383.

Craig, L., Weiss, T., 1998, Nutritional Status and Agricultural Surpluses in the Antebellum United States. In: Komlos, J., Baten, J. (Eds.), The Biological Standard of Living in Comparative Perspective, Franz Steiner Verlag, Stuttgart pp. 190-207.

Cuff, T., 2005, The Hidden Cost of Economic Development: The Biological Standard of Living in Antebellum Pennsylvania. (Ashgate, Vermont).

Eveleth, P.B., Tanner, J.M., 1976, Worldwide Variation in Human Growth. (Cambridge University Press, Cambridge).

Finley, J.B., 1857, Memorials of Prison Life (L. Swormstedt & A. Poe, Cincinnati).

Floud, R., Wachter, K., Gregory, A., 1990, Height, Health and History: Nutritional Status in the United Kingdom, 1750-1980 (Cambridge University Press, Cambridge).

Fogel, R., Engerman, S., Trussell, J., Floud, R., Pope, C., Wimmer, L., 1978, The Economics of Mortality in North America, 1650-1910: The Description of a Research Project, Historical Methods 11, 75-108.

Fogel, R.W.,1994, Economic Growth, Population Theory, and Physiology: The Bearing of Long-Term Processes on the Making of Economic Policy. American Economic Review 84, 369-395.

Gerber, D.A., 1976, Black Ohio and the Color Line 1860-1915 (University of Illinois Press, Urbana).

Godoy, R., Goodman, E., Levins, R., Leonard, W.R., 2005, Anthropometric Variability in the USA. Annals of Human Biology 32, 469-485.

Haines, M., 2004, Growing Incomes, Shrinking People—Can Economic Development be Hazardous to Your Health? Social Science History 28, 249-270.

Haines, M., 2006, Population Characteristics, In: Carter, S.B., Gartner, S.S., Haines, M.R., Olmstead, A.L., Sutch, R., Wright, G. (Eds), Historical Statistics of the United States, Earliest Times to the Present v. I, Cambridge University Press, New York.

Haines, M., Craig, L., Weiss, T., 2003, The Short and the Dead: Nutrition, Mortality and the 'Antebellum Puzzle' in the United States. Journal of Economic History 63, 382-413.

Herbert, P.R., Rich-Edwards, J.W., Manson, J.E., Ridker, P.M., Cook, N.R., O'Conner, G.T., Buring, J.E., Hennekens, C.H., 1993, Height and Incidence of Cardiovascular Disease in Male Physicians. Circulation 88, 1437-1443.

Johnson, D.M., Campbell, R.R., 1981, Black Migration in America: A Social Demographic History. (Duke University Press, Durham).

Jousilahti, P., Tuomilehto, J., Vartiainen, E., Ericsson, J., Puska, P., 2000, Relation of Adult Height to Cause-specific and Total Mortality: A Prospective Follow-up Study of 31,199 Middle-aged Men and Women in Finland. American Journal of Epidemiology 151, 1112-1120.

Komlos, J., 1987, The Height and Weight of West Point Cadets: Dietary Change in Antebellum America. Journal of Economic History 47, 897-927.

Komlos, J., 1992, Toward an Anthropometric History of African-Americans: The Case of Free Blacks in Antebellum Maryland. In: Goldin, C., Rockoff, H. (Eds.), Strategic Factors in 19$^{th}$ Century American Economic History. University of Chicago Press, Chicago, pp. 297-329.

Komlos, J., 1996, On Anomalies in Economic History: Reflections on the Antebellum Puzzle. Journal of Economic History 56, 202-214.

Komlos, J., 1998, Shrinking in a Growing Economy? The Mystery of Physical Stature during the Industrial Revolution. Journal of Economic History 58, 779-802.

Komlos, J., Coclanis, P., 1997, On the Puzzling Cycle in the Biological Standard of Living: The Case of Antebellum Georgia. Explorations in Economic History 34, 433-459.

Komlos, J, Baur, M., 2004, From Tallest to (one of) the Fattest: the Enigmatic

Fate of American Population in the 20th Century. Economics and Human Biology 2, 57-74.

Komlos, J., Breitfelder, A., 2007, The Height of US-born non-Hispanic Children and Adolescents Ages 2-19, born 1942-2002 in NHANES Samples. American Journal of Human Biology 20, 66-71

Lee, C., 1997, Socioeconomic Background, Disease, and Mortality among Union Army Recruits: Implications for Economic and Demographic History. Explorations in Economic History 34, 27-55.

Margo, R.A., Steckel R.H, 1982, Heights of American Slaves: New Evidence on Nutrition and Health. Social Science History 6, 516-538.

Margo, R.A., Steckel, R.H., 1983, Heights of Native Born Whites during the Antebellum Period. Journal of Economic History 43, 167-174.

Nelson, D., Kleerekoper, M., Peterson E., Parfitt, A.M., 1993, Skin Color and Body Size as Risk Factors for Osteoporosis, Osteoporosis International 3, 18-23.

Pope, C. L., 1992, Adult Mortality in America before 1900: A View from Family Histories. In: Goldin, C., Rockoff, H. (Eds.), Strategic Factors in 19th Century American Economic History. University of Chicago Press, Chicago, pp. 287-296.

Rees, R., Komlos, J., Long, N., Woitek, U., 2003, Optimal Food Allocation in a Slave Economy. Journal of Population Economics 16, 21-36.

Riggs, P., 1994, The Standard of Living in Scotland, 1800-1850, In Komlos, J. (Ed.), Stature, Living Standards and Economic Development: Essays in Anthropometric History. University of Chicago Press: Chicago. pp. 60-75.

Ruggles, S., Sobek, M., Alexander, T., Fitch, C.A., Goeken, R., Hall, P.K, King, M., and Ronnander, C., 2004, Integrated Public Use Microdata Series: Version 3.0 [Machine-readable database]. Minneapolis, MN: Minnesota Population Center [producer and distributor].

Sokoloff, K.L., Villaflor, G.C., 1982, The Early Achievement of Modern Stature in America. Social Science History 6, 453-481.

Song, Y.M., Smith, G.D., Sung, J., 2003, Adult Height and Cause-specific Mortality: A Large Prospective Study of South Korean Men. American Journal of Epidemiology 158, 479-485.

Steckel, R.H., 1979, Slave Height Profiles from Coastwise Manifests. Explorations in Economic History 16, 363-380.

Steckel, R.H., 1986, A Peculiar Population: The Nutrition, Health, and Mortality of American Slaves from Childhood to Maturity. Journal of Economic History 46, 721-742.

Steckel, R.H., 1992, Stature and Living Standards in the United States. In: Gallman, R.E., Wallis, J.J. (Eds.), American Economic Growth and Standards of Living Before the Civil War. University of Chicago Press, Chicago, pp. 265-308.

Steckel, R.H., 1995, Stature and the Standard of Living. Journal of Economic Literature 33, 1903-1940.

Steckel, R.H., 1996, Percentiles of Modern Height Standards for Use in Historical Research. Historical Methods 29, 157-66.

Steckel, R.H., Haurin, E., 1994, Health and Nutrition in the American Midwest: Evidence from the Height of Ohio National Guardsman 1850-1910. In: Komlos,

J. (Ed.), Stature, Living Standards and Economic Development. University of Chicago Press, Chicago, pp. 117-128.

Sunder, M., 2003, On the Biological Standard of Living of the Middle Class in 19th Century America, paper presented at the 63rd Annual Meeting of the Economic History Association, Nashville, TN.

Sunder, M., 2004, The Height of Tennessee Convicts: Another Piece of the Antebellum Puzzle. Economics and Human Biology 2, 75-86.

Sunder, M., Woitek, U., 2005, Boom, Bust, and the Human Body: Further Evidence on the Relationship between Height and Business Cycles. Economics and Human Biology 3, 450-466.

Tanner, J.M., 1977, The Human Growth Curve. In Harrison, G.A., Weiner, J. S., Tanner, J.M., Barnicot, N.A. (Eds.), Human Biology: an Introduction to Human Evolution, Variation, Growth and Ecology. Oxford University Press, Oxford, pp. 301-319.

Taylor, H.L., 1993, City Building, Public Policy, the Rise of the Industrial City, and Black Ghetto Slum Formation in Cincinnati, 1850-1940. In Taylor, H.L. (Ed.), Race and the City: Work, Community, and Protest in Cincinnati, 1820-1970. University of Illinois Press, Urbana, pp. 156-192.

Woitek, U., 2003, Height Cycles in the 18th and 19th Centuries. Economics and Human Biology 1, 243-257.

Table 1: Theft as a Share of All Crimes, by Race, Age, and Year Incarcerated

| | White Adults | Black Adults | White Youth | Black Youth |
|---|---|---|---|---|
| 1870 | 61.03 | 64.49 | 74.59 | 70.42 |
| 1880 | 62.08 | 61.54 | 76.02 | 67.29 |
| 1890 | 58.58 | 49.21 | 75.62 | 66.16 |
| 1900 | 53.84 | 52.92 | 71.1 | 66.31 |
| 1910 | 53.27 | 55.28 | 68.92 | 62.5 |

Source: Ohio prison data set

Table 2: Occupational Distribution of Ohio Population and Ohio Prison Inmates

| | 1850-1910 | | 1850-1870 | | 1880-1910 | |
|---|---|---|---|---|---|---|
| | Population | Prison | Population | Prison | Population | Prison |
| | | | White | | | |
| White Collar | 0.169 | 0.167 | 0.115 | 0.135 | 0.194 | 0.177 |
| Skilled | 0.181 | 0.317 | 0.170 | 0.372 | 0.187 | 0.299 |
| Unskilled | 0.372 | 0.357 | 0.316 | 0.273 | 0.399 | 0.384 |
| Farmer | 0.278 | 0.159 | 0.398 | 0.220 | 0.220 | 0.140 |
| N | 31168 | 16023 | 12107 | 3848 | 19061 | 12175 |
| | | | Black | | | |
| White Collar | 0.058 | 0.110 | 0.033 | 0.147 | 0.065 | 0.103 |
| Skilled | 0.066 | 0.185 | 0.074 | 0.285 | 0.064 | 0.167 |
| Unskilled | 0.808 | 0.599 | 0.761 | 0.371 | 0.822 | 0.642 |
| Farmer | 0.068 | 0.105 | 0.132 | 0.196 | 0.049 | 0.088 |
| N | 851 | 3406 | 361 | 536 | 490 | 2870 |

Source: For population figures, Integrated Public Use Microdata Series (IPUMS) Census samples for Ohio for 1850, 1860, 1870, 1880, 1900, and 1910. Shares are based on weighted calculations. Unweighted N's are reported. For prison figures, the Carson prison sample. Figures reflect prisoners received 1850-1910 for the full period, and 1850 to 1879 and 1880 to 1910 for the subperiods. All figures based on men aged 23-55 with a reported occupation.

Table 3: Mean Adult Height by Category (in Centimeters)

| | White | | Black | | Height |
|---|---|---|---|---|---|
| | Height | N | Height | N | Difference |
| Farmer | 173.85 | 2872 | 172.10 | 372 | 1.75 |
| Non-Farmer | 171.92 | 14465 | 170.50 | 3148 | 1.42 |
| Age 23-45 | 172.28 | 15806 | 170.63 | 3325 | 1.65 |
| Age 46-55 | 171.96 | 1531 | 171.27 | 195 | 0.69 |
| Non-Mulatto | | | 170.49 | 3075 | |
| Mulatto | | | 171.85 | 445 | |
| Region of Birth | | | | | |
| New England | 172.11 | 610 | 171.18 | 32 | 0.93 |
| Middle Atlantic | 171.55 | 3793 | 169.86 | 209 | 1.69 |
| Great Lakes (exc. Ohio) | 171.75 | 1128 | 170.17 | 106 | 1.58 |
| Ohio | 172.33 | 8913 | 170.89 | 983 | 1.44 |
| South | 173.18 | 2637 | 170.63 | 2082 | 2.55 |
| Plains and West | 172.10 | 256 | 171.17 | 108 | 0.93 |
| Water | | | | | |
| Lake | 171.21 | 2476 | 169.89 | 455 | 1.32 |
| No Lake | 172.41 | 14861 | 170.78 | 3058 | 1.63 |
| River | 172.15 | 3851 | 170.37 | 1071 | 1.78 |
| No River | 172.28 | 12030 | 170.93 | 1849 | 1.35 |
| Southern County | 172.42 | 4523 | 170.53 | 1188 | 1.89 |
| Non-Southern County | 172.18 | 12814 | 170.73 | 2332 | 1.45 |

Source: Ohio prison data set.

Notes: Southern counties are those along the Ohio river, plus those immediately North of these border counties: Hamilton, Clermont, Brown, Adams, Scioto, Lawrence, Gallia, Meigs, Washington, Monroe, Belmont, Jefferson, and Columbiana, Butler, Carroll, Clinton, Guernsey, Harrison, Highland, Jackson, Morgan, Noble, Pike, Stark, Vinton, and Warren. Regions are defined as follows: New England = CT, ME, NH, RI, VT and "New England;" Middle Atlantic = NJ, NY, and PA; Great Lakes = IL, IN, MI, and WI; South = AL, AR, DE, DC, MD, FL, GA, KY, LA, MO, MS, NC, SC, TN, TX, VA, and

WV; Plains and West = IA, KS, MN, NE, ND, SD, AZ, NM, OK, AK, CA, ID, UT, CO, MT, NV, OR, WA, WY, and "Indian Territory." Counties that border the Ohio River are Adams, Belmont, Brown, Clermont, Columbia, Gallia, Hamilton, Jefferson, Lawrence, Meigs, Monroe, Scioto and Washington. Counties that border the Miami River are Butler, Champaign, Clark, Hamilton, and Montgomery. Counties that border the Scioto River include Franklin, Pickaway, Pike, Ross and Scioto. Counties that bordered lakes are Ashtabula, Cuyahoga, Erie, Lake, Lorain, Lucas, and Ottawa counties.

Table 4: Mean Youth Height by Category

| | White | | Black | | Height |
|---|---|---|---|---|---|
| | Height | N | Height | N | Difference |
| | A. By Age (centimeters) | | | | |
| 14 | 160.56 | 23 | 160.71 | 17 | -0.15 |
| 15 | 164.20 | 80 | 164.87 | 25 | -0.67 |
| 16 | 167.35 | 266 | 166.83 | 70 | 0.52 |
| 17 | 169.47 | 646 | 167.68 | 144 | 1.79 |
| 18 | 170.10 | 885 | 168.33 | 204 | 1.77 |
| 19 | 171.45 | 1120 | 169.46 | 235 | 1.99 |
| 20 | 171.36 | 1125 | 170.56 | 232 | 0.80 |
| 21 | 172.10 | 1432 | 170.91 | 297 | 1.19 |
| 22 | 172.00 | 1575 | 170.87 | 327 | 1.13 |
| | B. By Characteristics (Age Standardized) | | | | |
| Farmer | 100.92 | 1242 | 100.09 | 161 | 0.83 |
| Non-Farmer | 99.81 | 5910 | 99.14 | 1390 | 0.67 |
| Non-Mulatto | | | 99.13 | 1228 | |
| Mulatto | | | 99.68 | 323 | |
| Region of Birth | | | | | |
| New England | 99.72 | 183 | 98.06 | 14 | 1.66 |
| Middle Atlantic | 99.51 | 1314 | 99.31 | 74 | 0.20 |
| Great Lakes (exc. Ohio) | 99.87 | 487 | 98.98 | 66 | 0.89 |
| Ohio | 100.07 | 4196 | 99.31 | 651 | 0.76 |
| South | 100.55 | 860 | 99.14 | 688 | 1.41 |
| Plains and West | 99.99 | 112 | 100.20 | 58 | -0.21 |
| Proximity to Water | | | | | |
| Lake | 99.66 | 1051 | 98.86 | 133 | 0.8 |
| No Lake | 100.06 | 6101 | 99.28 | 1418 | 0.78 |
| River | 99.88 | 2159 | 99.16 | 696 | 0.72 |
| No River | 100.05 | 4993 | 99.31 | 855 | 0.74 |
| Southern County | 100.04 | 1868 | 99.30 | 542 | 0.74 |
| Non-Southern County | 99.99 | 5284 | 99.21 | 1009 | 0.78 |

Each individual's height is standardized by the average height for whites of the same age.
See Table 1 for definition of regions and of southern counties.
Source: Ohio prison data set

Table 5: Composition of Regression Data Sets

| | Adult | | Youth | |
|---|---|---|---|---|
| | White | Black | White | Black |
| Mean Height (centimeters) | 172.241 | 170.667 | 171.072 | 169.597 |
| Share in Each Birth Cohort: | | | | |
| 1790 | .011 | .005 | | |
| 1800 | .024 | .009 | | |
| 1810 | .045 | .022 | .026 | .016 |
| 1820 | .050 | .034 | .038 | .016 |
| 1830 | .071 | .046 | .061 | .029 |
| 1840 | .126 | .092 | .098 | .080 |
| 1850 | .206 | .170 | .164 | .123 |
| 1860 | .239 | .238 | .234 | .190 |
| 1870 | .175 | .257 | .298 | .379 |
| 1880 | .053 | .128 | .073 | .150 |
| 1890 | | | .007 | .018 |
| Share from Each Region | | | | |
| New England | .035 | .009 | .026 | .009 |
| Mid-Atlantic | .219 | .059 | .184 | .072 |
| Plains and West | .015 | .031 | .016 | .037 |
| South | .152 | .591 | .088 | .397 |
| Great Lakes | .065 | .030 | .068 | .043 |
| Ohio | .514 | .279 | .587 | .420 |
| Share Near Lake | .143 | .129 | .147 | .086 |
| Share Near River | .306 | .473 | .302 | .449 |
| Share from Farm | .166 | .106 | .174 | .104 |
| Share from Southern County | .261 | .338 | .261 | .349 |
| Share Aged 46-55 (for Adults) | .088 | .055 | | |
| Share Mulatto (for Blacks) | | .126 | | .208 |
| Share at Each Age (for Youth) | | | | |
| 14 | | | .003 | .011 |
| 15 | | | .011 | .016 |
| 16 | | | .037 | .045 |
| 17 | | | .090 | .093 |
| 18 | | | .124 | .132 |
| 19 | | | .157 | .152 |
| 20 | | | .157 | .150 |
| 21 | | | .200 | .191 |
| 22 | | | .220 | .211 |
| N | 17337 | 3520 | 7152 | 1551 |

For adults, the "1790" birth cohort includes those born in the 1780s and 1790s, and the "1880" birth cohort includes those born in the 1880s and 1890s. These groups are pooled due to small cell sizes.

Table 6: Adult Height Regressions

| | All | | White | | Black | |
|---|---|---|---|---|---|---|
| | (Coeff) | (P-value) | (Coeff) | (P-value) | (Coeff) | (P-value) |
| Intercept | 172.104 | .01 | 172.008 | .01 | 171.029 | .01 |
| Race | | | | | | |
| White | Reference | | | | | |
| Black | -1.581 | .01 | | | Reference | |
| Mulatto | | | | | 1.215 | .01 |
| Ages | | | | | | |
| 22-45 | Reference | | Reference | | Reference | |
| 46-55 | -0.733 | .01 | -0.875 | .01 | .682 | .19 |
| Birth Cohort: | | | | | | |
| 1780-90 | 2.769 | .01 | 2.714 | .01 | 2.856 | .08 |
| 1800 | 1.812 | .01 | 1.824 | .01 | 1.536 | .20 |
| 1810 | 1.955 | .01 | 1.969 | .01 | 1.303 | .11 |
| 1820 | 1.702 | .01 | 1.850 | .01 | 0.177 | .80 |
| 1830 | 1.160 | .01 | 1.305 | .01 | -0.286 | .63 |
| 1840 | 0.392 | .01 | 0.620 | .01 | -1.403 | .01 |
| 1850 | 0.045 | .74 | 0.066 | .65 | -0.124 | .73 |
| 1860 | Reference | | Reference | | Reference | |
| 1870 | -0.218 | .11 | -0.342 | .02 | 0.250 | .44 |
| 1880-90 | -0.180 | .36 | -0.072 | .76 | -0.288 | .47 |
| Region of Birth | | | | | | |
| New England | -0.650 | .01 | -0.676 | .01 | 0.610 | .61 |
| Mid-Atlantic | -1.085 | .01 | -1.077 | .01 | -1.148 | .03 |
| Plains and West | 0.109 | .75 | 0.150 | .71 | -0.374 | .59 |
| South | 0.191 | .12 | 0.405 | .01 | -0.277 | .29 |
| Great Lakes | -0.276 | .15 | -0.229 | .25 | -0.525 | .44 |
| Ohio | Reference | | Reference | | Reference | |
| Lake | -0.662 | .01 | -0.601 | .01 | -0.960 | .01 |
| River | -0.354 | .01 | -0.319 | .01 | -0.580 | .04 |
| Farm | 1.425 | .01 | 1.424 | .01 | 1.381 | .01 |
| Southern County | 0.294 | .01 | 0.356 | .01 | 0.070 | .80 |
| F | 37.1 | | 28.9 | | 3.8 | |
| N | 20857 | | 17337 | | 3520 | |
| Adj. $R^2$ | .03 | | .03 | | .02 | |

Dependent variable = height (in centimeters)

All F statistics are statistically significant at a p-value of .01.

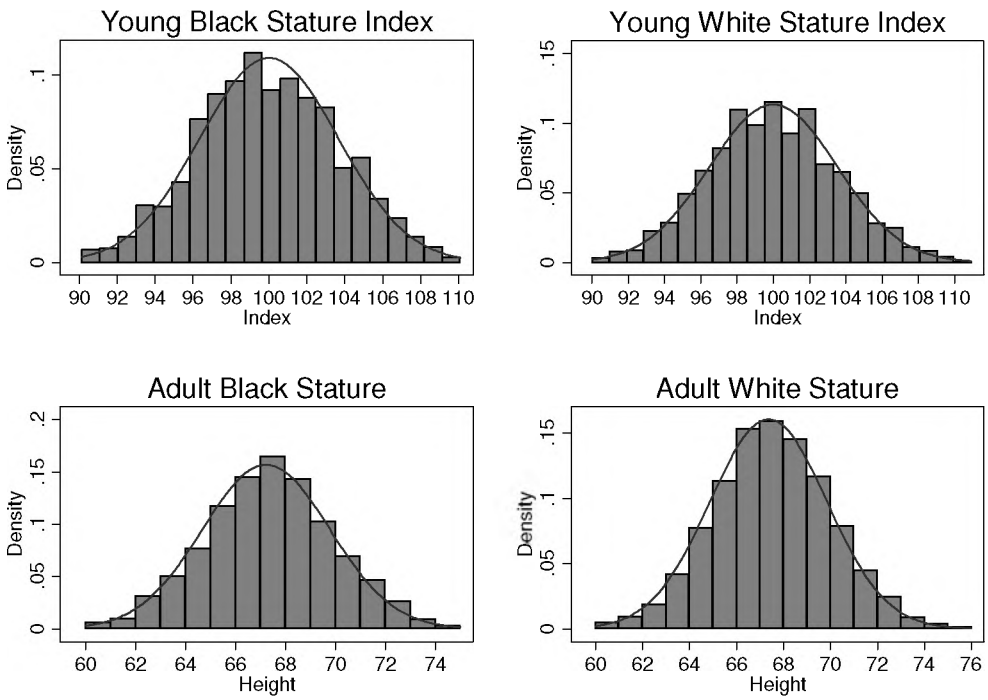
Table 7: Youth Height Regressions

| | All | | White | | Black | |
|---|---|---|---|---|---|---|
| | (Coeff) | (P-value) | (Coeff) | (P-value) | (Coeff) | (P-value) |
| Intercept | 172.623 | .01 | 172.548 | .01 | 171.702 | .01 |
| Race | | | | | | |
| White | Reference | | | | | |
| Black | -1.287 | .01 | | | Reference | |
| Mulatto | | | | | 0.668 | .17 |
| Birth Cohort | | | | | | |
| 1810 | 0.541 | .25 | 0.558 | .26 | -0.249 | .87 |
| 1820 | -0.528 | .19 | -0.572 | .17 | -0.559 | .71 |
| 1830 | -0.232 | .47 | -0.318 | .35 | 0.574 | .60 |
| 1840 | -0.423 | .11 | -0.306 | .28 | -1.483 | .05 |
| 1850 | -0.689 | .01 | -0.607 | .01 | -1.183 | .07 |
| 1860 | Reference | | Reference | | Reference | |
| 1870 | -1.105 | .01 | -1.074 | .01 | -1.290 | .01 |
| 1880 | -1.285 | .01 | -1.114 | .01 | -1.779 | .01 |
| 1890 | -0.493 | .50 | -0.762 | .39 | 0.039 | .98 |
| Region of Birth | | | | | | |
| New England | -0.707 | .13 | -0.568 | .23 | -2.258 | .21 |
| Mid-Atlantic | -0.945 | .01 | -0.974 | .01 | 0.077 | .93 |
| Plains and West | 0.268 | .59 | -0.123 | .84 | 1.262 | .21 |
| South | 0.329 | .09 | 0.703 | .01 | -0.272 | .46 |
| Great Lakes | -0.253 | .38 | -0.226 | .45 | -0.568 | .51 |
| Ohio | Reference | | Reference | | Reference | |
| Lake | -0.330 | .12 | -0.304 | .18 | -0.566 | .39 |
| River | -0.457 | .01 | -0.529 | .01 | -0.133 | .74 |
| Farm | 1.613 | .01 | 1.623 | .01 | 1.316 | .03 |
| Southern County | 0.322 | .08 | 0.307 | .14 | 0.381 | .35 |
| Age | | | | | | |
| 14 | -10.822 | .01 | -11.357 | .01 | -10.312 | .01 |
| 15 | -7.463 | .01 | -7.864 | .01 | -6.424 | .01 |
| 16 | -4.512 | .01 | -4.671 | .01 | -3.982 | .01 |
| 17 | -2.580 | .01 | -2.465 | .01 | -3.094 | .01 |
| 18 | -2.035 | .01 | -1.924 | .01 | -2.519 | .01 |
| 19 | -0.675 | .01 | -0.547 | .03 | -1.366 | .02 |
| 20 | -0.626 | .01 | -0.695 | .01 | -0.349 | .54 |
| 21 | 0.063 | .76 | 0.052 | .82 | -0.006 | .99 |
| 22 | Reference | | Reference | | Reference | |
| | | | | | | |
| F | 29.1 | | 23.2 | | 5.2 | |
| N | 8703 | | 7152 | | 1551 | |
| Adj. $R^2$ | .08 | | .07 | | .07 | |

Dependent variable = height (in centimeters)

All F statistics are statistically significant at a p-value of .01.

Figure 1: Height Distributions by Race for Adults and Youth

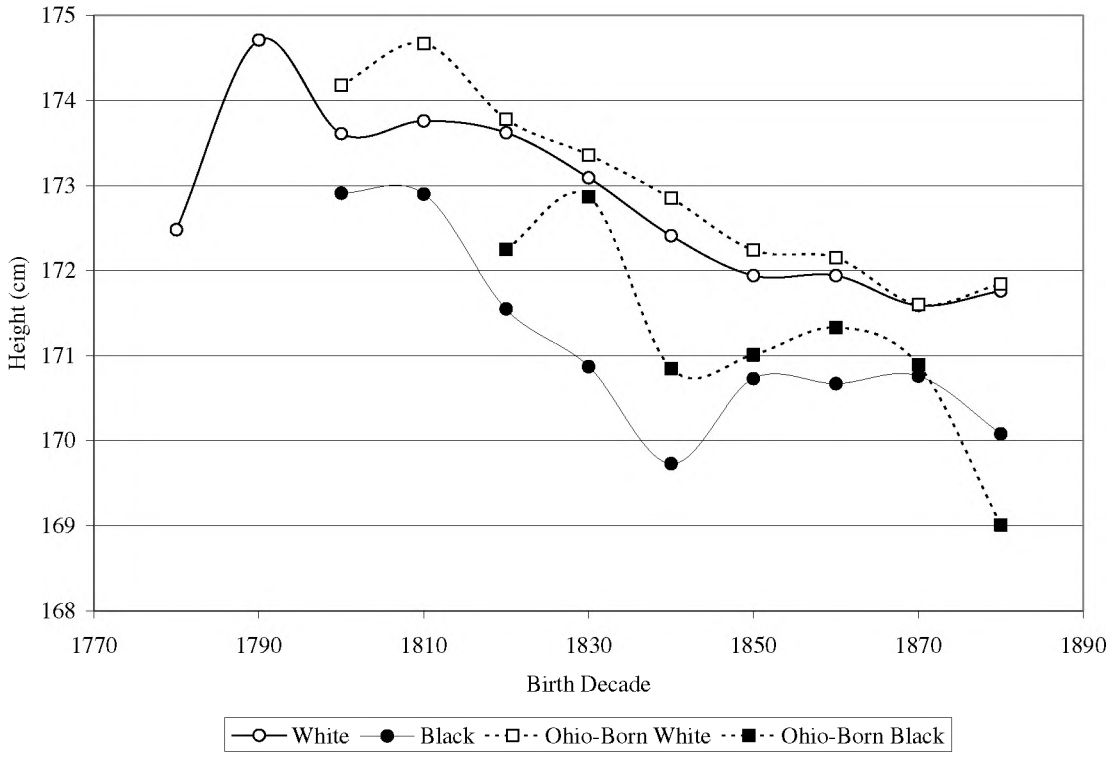



Descriptive Statistics:

| | Mean | Median | Standard Deviation | Skewness | Kurtosis |
|---|---|---|---|---|---|
| Black Youth (Index) | 99.37 | 99.24 | 3.95 | -.068 | 3.63 |
| White Youth (Index) | 100.13 | 100.15 | 3.69 | -.017 | 3.51 |
| Black Adult (Inches) | 67.80 | 68 | 2.69 | -.027 | 3.60 |
| Black Adult (cm) | 172.21 | 172.72 | 6.84 | | |
| White Adult (Inches) | 68.57 | 68.5 | 2.27 | -.018 | 3.32 |
| White Adult (cm) | 174.17 | 173.99 | 5.77 | | |

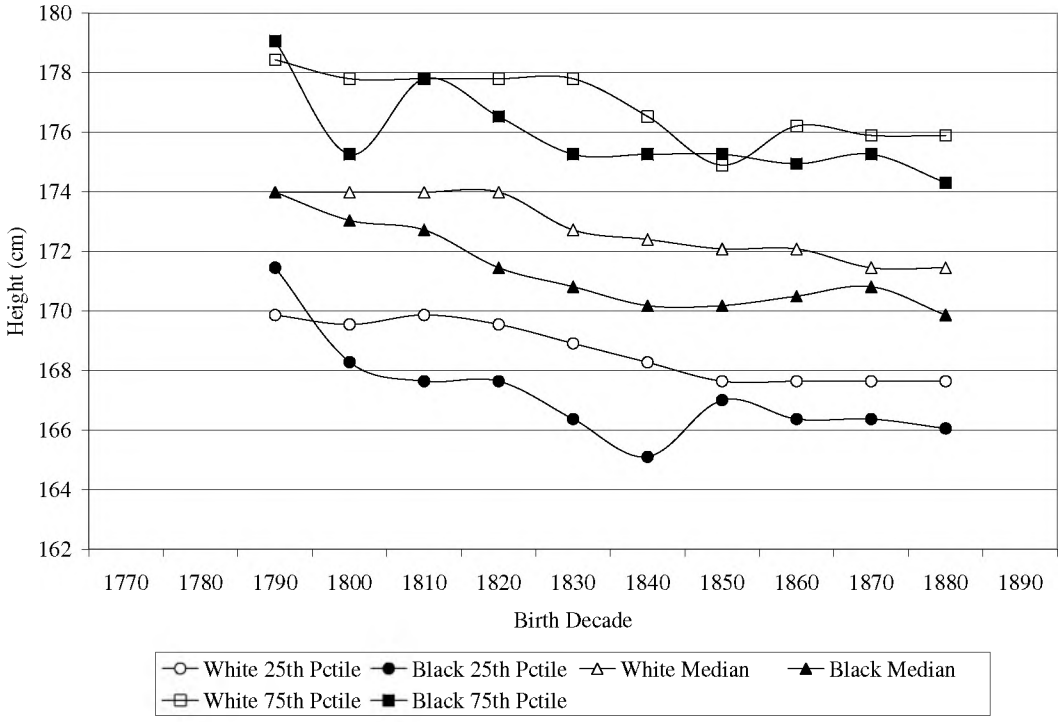
Source: Ohio Prison data set.

Figure 2: Mean Height by Race and Year of Birth, Adult Inmates



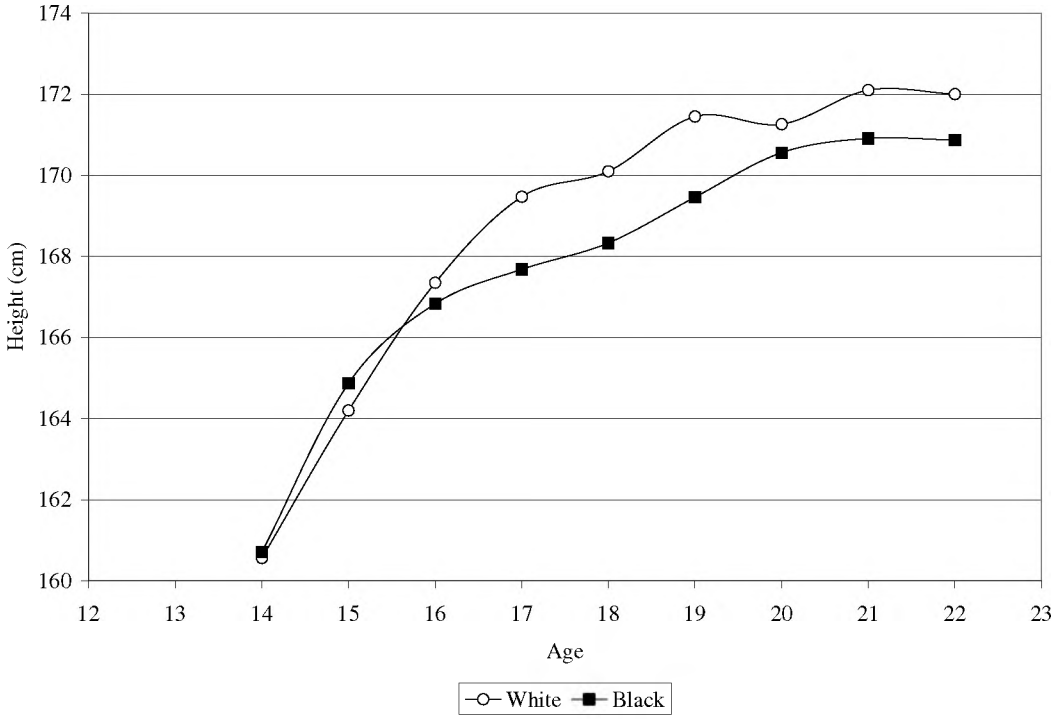

Source: Ohio Prison data set

Figure 3: Adult Height by Quartile, by Race and Year of Birth




Source: Ohio Prison data set

Figure 4: Mean Height of Youths by Age

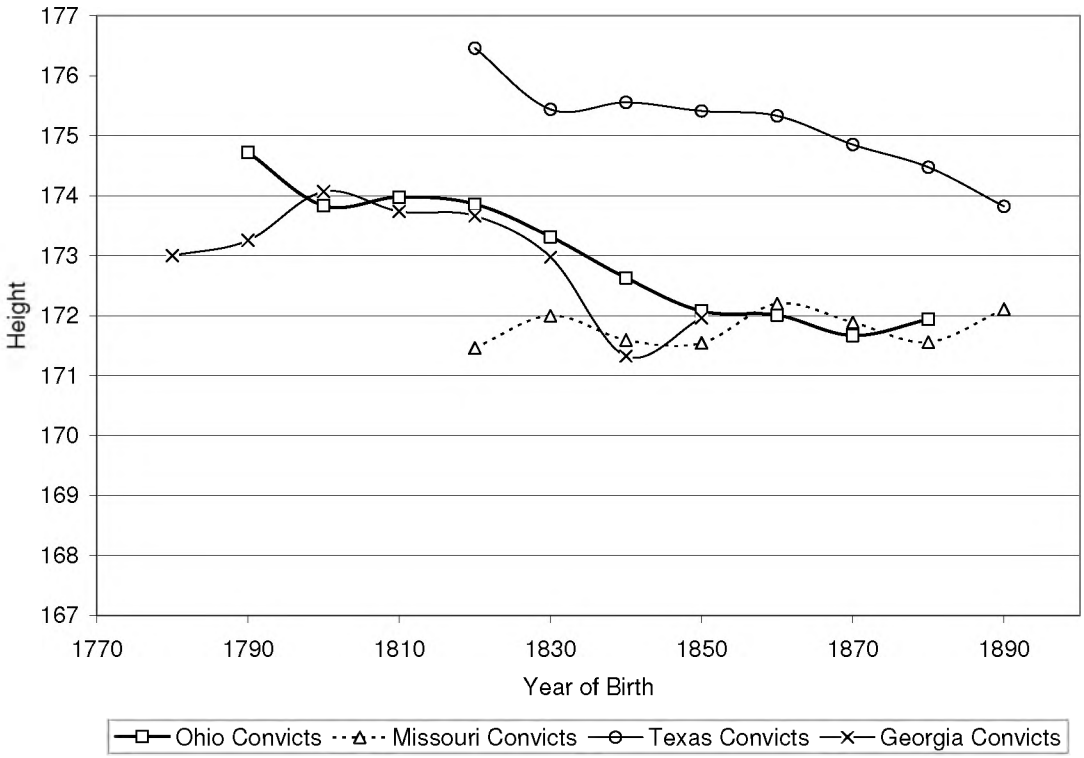



Source: Ohio Prison data set

Figure 5: Mean Standardized Youth Height by Race and Year of Birth

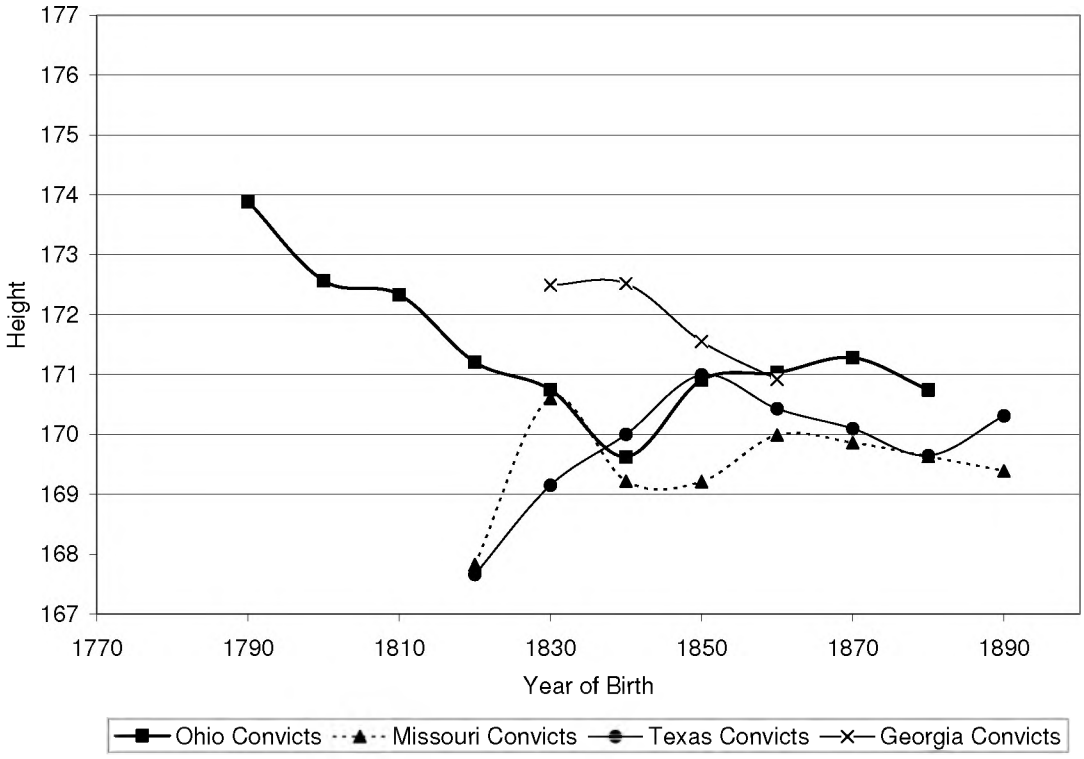

Source: Ohio Prison data set

Figure 6: Trends in White Adult Stature Based on Prison Records




Sources: For Ohio, race-specific regressions in Table 6, evaluated for the reference group (Ohio-born, aged 22-45, convicted in a non-Southern county that was not adjacent to a river or lake). For Missouri, Carson 2007, Table 5 (race-specific regressions), evaluated for the reference group (unskilled, born in the Plains region). For Texas, Carson 2006, Table 2, (race-specific regressions), evaluated for unskilled workers born in the Southeast. For Georgia, Komlos and Coclanis 1997, Table 2, evaluated for unskilled workers born in Georgia and convicted in the plantation belt. See text for further details.

Figure 7: Trends in Black Adult Stature based on Prison Records




Sources: See Figure 6 and text.